SIEMENS

POLYMOBIL Plus

SP

Service Instructions

From Serial No. 12000

English
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Chapter	Page	Revision
All	All	02

Document revision level

The document corresponds to the version/revision level effective at the time of system delivery. Revisions to hardcopy documentation are not automatically distributed.

Please contact your local Siemens office to order current revision levels.

Disclaimer

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Text emphasis

⚠DANGER	**DANGER indicates an immediate danger that is likely to result in death or serious physical injury.**
⚠WARNING	**WARNING indicates a risk of danger that may lead to death or to serious physical injury.**
⚠CAUTION	**CAUTION used in conjunction with the safety alert symbol indicates a risk of danger that is likely to result in slight or moderate physical injury and/or damage to property.**
NOTICE	**NOTICE used without the safety alert symbol indicates a risk of danger that if disregarded leads to or may lead to an undesirable result or state other than death, physical injury or damage to property.**
NOTE	**NOTE contains information that emphasizes proper use of the equipment or proper execution of a procedure, i.e. hints, tips.**

Symbols

Checks and adjustments that must be performed with radiation ON are identified by the radiation warning symbol.

This symbol means "Dangerous voltage".

Checks marked with this symbol are to be entered into the test certificate at the end of these instructions.

This symbol means "Attention, consult the documentation".

This symbol indicates components sensitive to electrostatic discharge (ESD).

Required documents

- Block circuit diagram X 069I
- Function description SPR8-125.041...
- Instructions for use SPR8-125.201.02...

NOTE **A detailed A 3 circuit diagram can be ordered under item number 18 20 377 X069I.**

Tools, measurement and auxiliary devices

NOTE **All tools, measurement and auxiliary devices with the exception of those marked " * " are listed along with their specifications in the STC (Service Tools Catalog).**

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- Standard service kit*
- Digital multimeter
- 2-channel memory oscilloscope
- mAs meter
- Dose meter
- Protective conductor meter
- Equivalent leakage current meter
- Torque wrench 20 Nm - 100 Nm
- Loctite 242
- Current transformer (50 A : 50 mA)* (Part No. 31 51 289)
  In addition, a metal film resistor with
  10 Ohms; 0.5 W; 1 % is required*
  Refer also to Speed Info 06/91
- Calibration tool for DAP measuring system (Part No. 65 84 978)

⚠WARNING **Dangerous electrical voltage present during service work!**

- **Risk of death or serious physical injury.**
- **The oscilloscope has to be connected to ground to perform measurements. A TEK video isolator and the trigger set have to be used when ground loops may distort the measurement results (see ARTD-002.731.22..).**

Safety information and protective measures

NOTICE

- **The following items must be complied with when performing service work and tests:**
  - **The product-specific safety information in the document**
  - **The safety information in TD00-000.860.01.. in the Register of the POLYMOBIL Plus binder**
  - **The safety information contained in ARTD Part 2.**

⚠WARNING

Dangerous X-radiation during checks and adjustment work steps.

Risk of death or serious physical injury.

For checks and adjustments that must be performed with radiation switched on, the prescribed radiation safety measures must be observed; if necessary, wear radiation protective clothing (see also ARTD-002.731.02.. and ARTD-002.731.38.. General Guidelines for Technical Service). These checks and adjustments are explicitly identified on the following pages with the radiation warning symbol  **.**

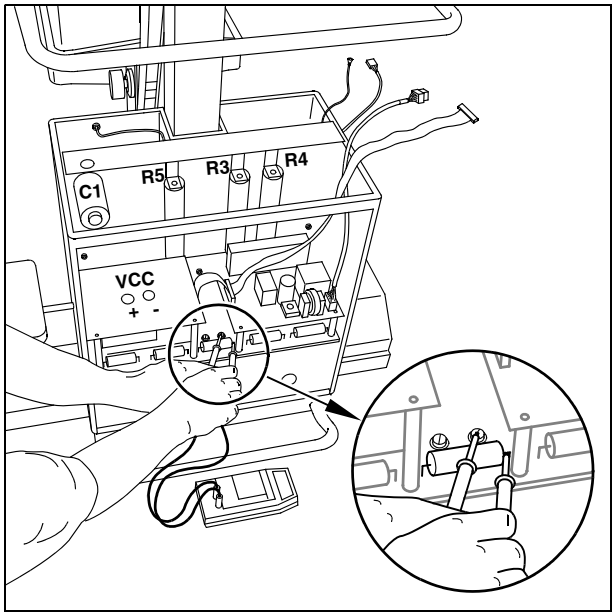

Fig. 1

⚠DANGER

When working on the open system, there is a danger of <u>Electric shock</u> !

Contact with current-carrying parts will lead to death or to serious physical injury.

- **The capacitor bank can still be charged.**
  Do not attempt to work on the system while this condition exists.
- **After switching off the system, approximately 450 V may still be present in the system, even after disconnecting the line voltage plug. Within 10 minutes this voltage will drop to approximately 10 V.**
- **Always measure the actual voltage present with the DVM at test points -VCC and + VCC on the D 960 inverter board or (more accessible) on the D 970 capacitor board at the + connection point of capacitor C3 and on the right side of fuse F3 (see Fig. 1).**
- **LED's V1 ... V10 on D 970 go out at a significantly higher voltage level and therefore are not reliable safety indicators.**
- **If a fuse on the D 970 has responded, high voltage may still be present at the affected capacitor even after a prolonged period of time.**
- **The capacitor discharging circuit utilizes the D925 board, CS and LS relays. If connectors X3 or X9 on D 925 or D 950 are not inserted or if there is a defect in the circuit, the C-bank will not discharge.**
  This can cause life-threatening voltage to be present in the system even after a prolonged period of time.
- **Refer also to chapter "Replacing the capacitor bank".**

- Connect the POLYMOBIL Plus only to a line voltage supply (line voltage receptacle) that complies with the requirements of VDE 0107 or corresponds to the local national regulations.
- Disconnect the POLYMOBIL Plus at the line voltage **OFF** switch on the operating console and disconnect the **line voltage plug** prior to any service work**.**

- Remove or insert boards with the generator switched OFF only; observe ESD guidelines when handling boards.

Replacing damaged or missing screws

- Damaged or missing screws may only be replaced by steel screws as specified in the installation drawings conforming to DIN267 and must have the specified tensile strength.

NOTICE **Replacement of screws.**

All Allen screws must have a tensile strength rating of 8.8 !

Cleaning

- The unit must always be switched off or disconnected before cleaning.
- Use only water to clean the unit or a lukewarm, diluted solution consisting of water and a household cleaning agent.
- Do not use abrasive cleaning agents or organic solvents such as benzine, alcohol or spot remover. Do not spray with water.
- For additional information, refer to the Instructions for use, chapter "Cleaning/ Disinfection".

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Preparation

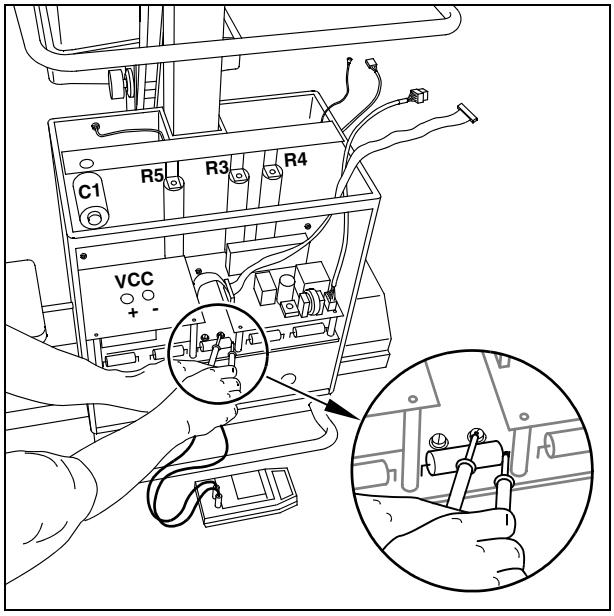

Fig. 1

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- **The capacitor bank can still be charged.**
  Do not attempt to work on the system while this condition exists.
- **For details see chapter "Prerequisites".**

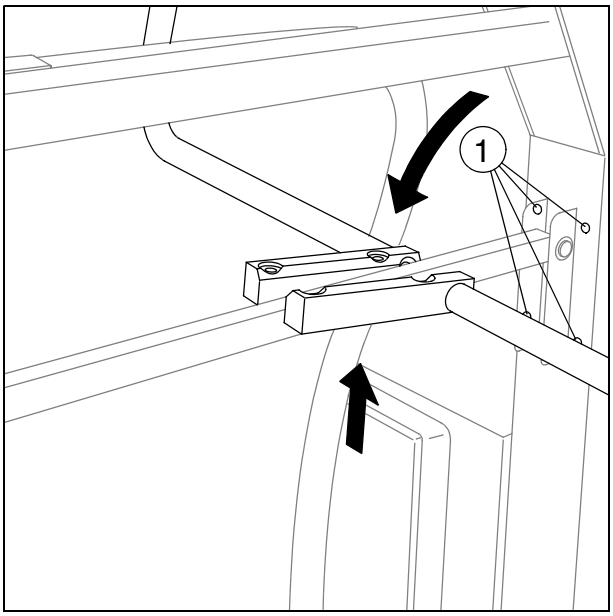


Fig. 2

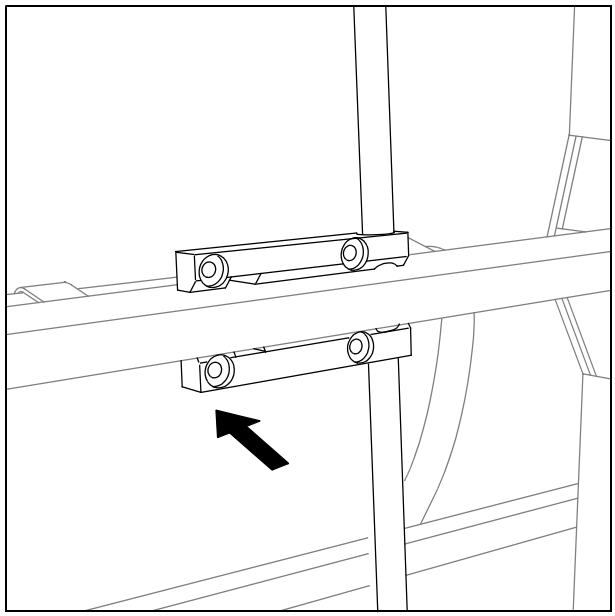


Fig. 3

To check the assemblies and remove the upper covers, the handles and the lower front cover of the switchbox.

Proceed as follows:

- Switch POLYMOBIL Plus **OFF** and disconnect the line voltage plug.
- Remove the four Allen screws (1/Fig. 2) in the handle and remove the handle (see Fig. 2 and Fig. 3).

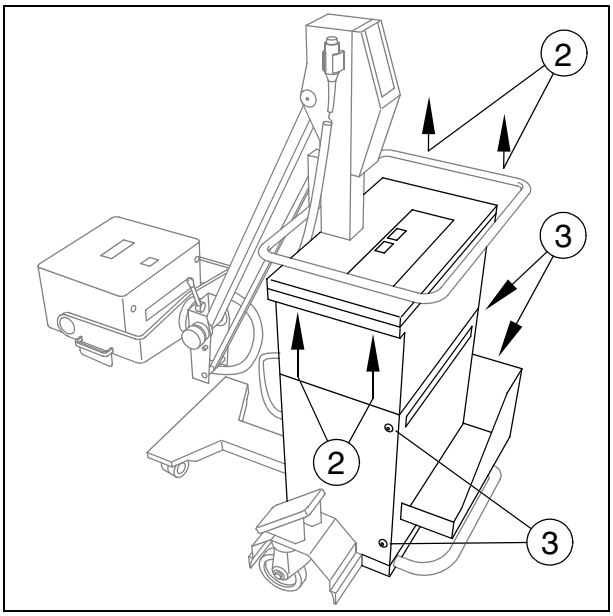


Fig. 4

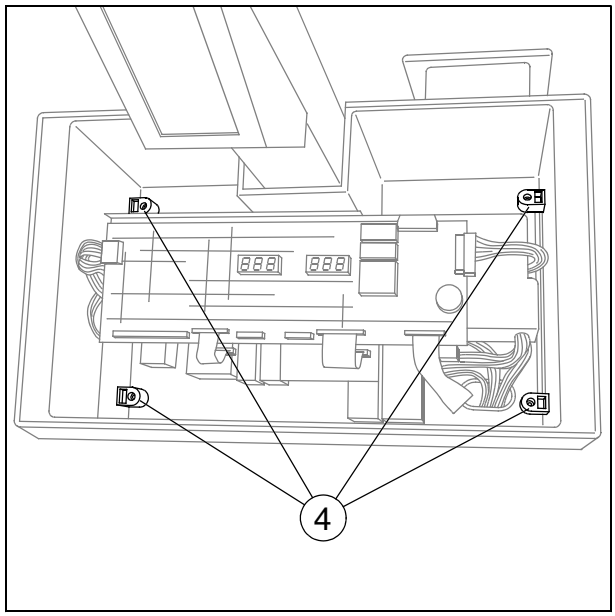


Fig. 5

- Remove the four Allen screws at the bottom of the switchbox cover (2/Fig. 4) and remove the cover.
- After removing the four panel screws (3/Fig. 4), remove the bottom cover at the front with the cassette tray.

⚠WARNING

When working on the open system, there is a danger of

<u>Electric shock</u> !

Risk of death or serious physical injury.

Always measure the actual voltage present with the DVM at test points -VCC and + VCC on the D 960 inverter board or (more accessible) on the D 970 capacitor board at the + connection point of capacitor C3 and on the right side of fuse F3.

- Remove the four screws of the top housing (4/Fig. 5)
- To stay clear of the exposure guide holder, tilt the housing forward and lift it up to remove it.

Position and function of the LED's, fuses, test points and potentiometers

NOTE	See block diagram for the location of components and boards.

D915 CPU, control and measurement value acquisition

LED:

V22	Preparation **ON**
V23	Exposure **ON**
V24	Error occurred
V25	not used
V34	Radiation **ON**

Test points:

X15	Pin	Color	
	1	black	Ground (+ 5 V)
	3	black	Ground (+ 5 V)
	4	red	+ 5 V ± 5 %
	5	brown	+15 V ± 10 %
	6	blue	Ground (+/- 15 V)
	7	yellow	-15 V ± 10 %

Potentiometers:

P1	Setting of the mAs counter
P2	OFFSET mAS - converter **Set at the factory - Do not change!**
P3	Max. filament inverter frequency
P4	Max. main inverter frequency
P5	Adjustment/setting of filament heating circuit
P6	Nominal filament current (standby), nominal tube current (exposure) **Set at the factory - Do not change!**
P7	Nominal kV value

Reset - switch
SW2

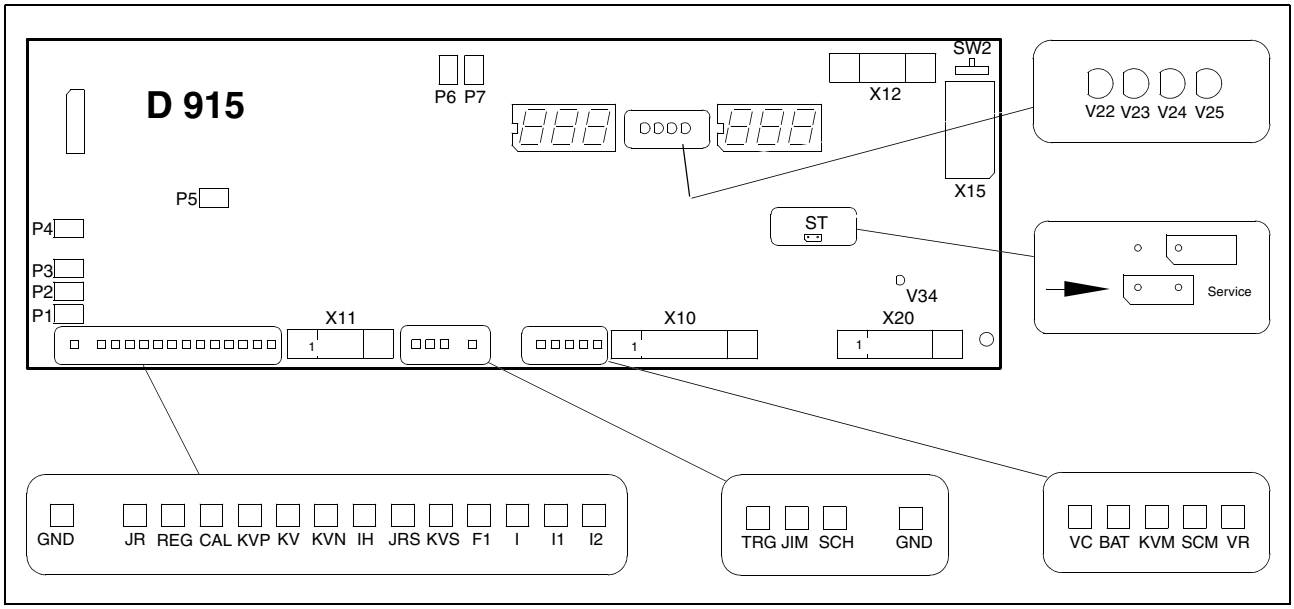


Fig. 6

D925 rotating anode starter, filament inverter, ON/OFF switching circuit

LED:

VP	+15 V for inverter frequency ok
+12V	+12.5 V auxiliary voltage ok
I/O	+12.5 V auxiliary voltage for I/O ok
AR	Line voltage for anode starter ok
+DC, -DC	300 V voltage for filament ok

Fuses:

F1	10 AT	+ 12.5 V for collimator lamp
F3	0.6 AT	Auxiliary voltage +12.5 V for I/O
F4	0.6 AT	Auxiliary voltage +12.5 V
F5	3.2 AF	Line voltage for anode starter
F6	1.0 AT	Line voltage for filament circuit
F7	10 AT	Power
F8	10 AT	Power

Measurement points:

VP	+15 V ± 10 % for inverter frequency
P12	+ 12.5 V ± 10 % auxiliary voltage
GNDL	Ground (+ 12.5 V)

X4	Pin	Color	
	1	red	+12.5 V ± 10 %
	2	red	+12.5 V ± 10 %
	3	red	+12.5 V ± 10 %
	4	black	Ground (+12.5 V)
	5	black	Ground (+12.5 V)
	6	black	Ground (+12.5 V)

U1 power supply unit 5 V ± 5% / 15 V ± 10 %

Fuse: 2 A T

U2 power supply unit 12.5 V ± 10 %

Fuse: 5 A T

D950 capacitor charging circuit

LED:

LINE (V25)	Line voltage ok
450 VCC (V30)	Capacitor voltage present (the voltage can also be considerably lower than 450 V)

Fuse:

F1	10 AT	Charging circuit

Test points:

ERR	Error output charging error
VC	Capacitor voltage 1 V $\triangleq$ 100 V
IC	Capacitor charging current
FR1	Charging circuit frequency (dependent on the line voltage and VC)
GND	Ground
CAR	Signal to enable the charger
FR2	Frequency of the auxiliary power supply
OK	Signal to indicate the full charge

D970 capacitor bank

LED:

V1 - V10	Capacitor voltage present at C1 - C10

Fuse:

F1 - F10	20AF	Capacitor charging voltage for C1 - C10
F11	80AF	Capacitor voltage for inverter
F12	20AF	Charging voltage for capacitor bank

Test points:

-VCC, +VCC	Capacitor voltage

Status of the LED's (optimum condition)

a) POLYMOBIL Plus OFF, line voltage plug connected:

D925:	LED	+12 V	ON
	LED	I/O	ON
D950:	LED	450 VCC (V30)	glows for 10 minutes following shutdown
D970:	all LED's		glows for 10 minutes following shutdown

b) POLYMOBIL Plus ON, standby

D915: The exposure values are displayed

D925:	LED	VP	ON
	LED	+12 V	ON
	LED	I/O	ON
	LED	AR	ON
	LED	+DC	ON
	LED	-DC	ON
D950:	LED	LINE (V25)	ON
	LED	450 VCC (V30)	ON
D970:	all LED's		ON

c) Preparation

All LED's as described under b) and also V22 on D915.

d) Exposure

All LED's as described under b) and also V22 and V23 as well as radiation indicator V34 on D915.

In the case of an error, V24 on D915 glows (red).

Error messages

NOTE

- **Error messages Err 1 and initialization errors Err 90, Err 96 and Err 97 block the generator so that the system must be switched off and switched back on again.**
- **"StandBy" error messages disappear when the error is cleared.**
- **Error messages which occur during an exposure will continue to flash until another key is activated.**

a) During initialization

Err 90	EPROM checksum	
Err 96	KVnom error	
Err 97	mAnom error	

b) During standby

Err 1	Capacity charge error	Charging circuit error
Err 2	+15 VError	
Err 3	Vfil < Vstby	
Err 4	Vfil > Vstby	
Err 5	KVact ≠ 0	
Err 6	mAact ≠ 0	
Err 7	Rot ≠ 0	
Err 8	Braking failure	Error in the rotating anode circuit
Err 9	Pressure switch	Oil pressure switch in the single tank is active
Err 30	Fast capacitor charge	Capacitor bank is charging too fast
Err 31	Slow capacitor charge	Capacitor bank is charging too slow
Err 33	Inverter Error	
Err 34	Filament circuit Inverter Short Circuit	

c) During exposure

Err 10	Rot = 0	No rotating anode acceleration
Err 11	Short circuit in main inverter	Short circuit in the main inverter
Err 12	KVmax	
Err 13	Imax	
Err 14	KVact < KVnom	
Err 15	mAact < mAnom	
Err 17	Maximum exposure time	Max. exposure reached
Err 18	Exposure not completed	Exposure time not completed (exposure release switch released)
Err 20	Capacitor not ready	Capacitor bank not completely charged
Err 21	Vfil > Vmax during prep	Maximum filament heating exceeded during preparation
Err 22	Maximum prep time	Max. preparation time exceeded

Troubleshooting after error messages

Err 1	**Capacitor charge error** - Has the system not been used for a long period of time (higher capacitor leakage current)? ⇨ If the error occurs after switching the system off and back on again, configure the capacitor bank (see chapter "Service program", page 4-2). - Are the discharge resistors permanently connected? - Has the temperature sensor on D950 responded (D950 TP 'TP')? - Has overvoltage been detected in the C-bank? (D950 TP 'VC') - Is there a short on D950? The error appears only when the short circuit is continuous. Replace D950.
Err 2	**+ 15 V - Error** - Check the fuse on power supply U1. - Is power supply U1 defective?
Err 3	**Vfil < Vstby (no or insufficient filament current)** - Do 'V1' (-DC) and 'V2' (+DC) flash on D925? Otherwise check fuse F6. - No filament frequency? Check D915. - Connection D925 =>X-ray tube unit (X5). - Connection D925 => D915 (X11). - Check X-ray tube assembly. - D925 defective.
Err 4	**Vfil > Vstby (filament current is too high)** - Do 'V1' (-DC) and 'V2' (+DC) flash on D925? Otherwise check fuse F6. - Filament frequency too high? - A/D converter on D915 defective? => Replace D915. - Short circuit at the output of the filament inverter =>check connection to/in the X-ray tube assembly.
Err 5	**KVact ≠ 0** - No connection to the single tank generator (D915 X8)? - Plug-in connection on D900 in the single tank generator ok?
Err 6	**mAact ≠ 0** - Error in the measurement acquisition on D915? => Replace D915. - No connection to the single tank generator (D915 X8)? - Plug-in connection on D900 in the single tank generator ok?
Err 7	**Rot ≠ 0** (rotating anode speed ≠ 0) - Error on D915 or D925.

Err 8	**Braking failure (error when braking the rotating anode - a current was measured in the auxiliary capacitor C2 during braking.)** - D915TP 'I1'. No current must be measured here when braking. - D915 TP 'I2'. Braking current must be measured here. - TRIAC 'V7' or 'V8' defective? => Replace D925.
Err 9	**Pressure switch (oil pressure switch in the single tank generator is active)** - Tube is overheated? - Measure D915 plug X8 at pin 8. In case of malfunction, 0 V are measured.
Err 10	**Rot = 0 (rotating anode speed is 0 on exposure)** The error is only displayed as long as preparation is depressed. - LED 'AR' on D925 flashes; is fuse F5 ok? - Measure at TP 'I1' and 'I2'. Current has to be present during acceleration. - Check D925. - Is the power factor correction capacitor C2 defective? - Connection to/in the single tank generator ok?
Err 11	**Short circuit in main inverter** - Check D960. - Check D915. - Main inverter frequency too high?
Err 12	**KVmax** - Interruption of KVact measurement. Measure TP 'KVN' and 'KVP' on D915. Both signals must have the same amplitude. - 'KVN' or 'KVP' > 70 kV. - Error in kV measurement circuit? - Error in kV control circuit?
Err 13	**Imax** The tube or filament current is recorded. - Check the filament circuit. - Exposure filament basic value incorrectly set (P5 on D915)? - Tube arcing? If kVact < kVnom, Err 14 or Err 13 is detected and displayed. See also trouble-shooting information under Err 14.
Err 14	**KVact < KVnom** - Voltage in the capacitor bank too low (D950 TP 'VC')? - Defective capacitors /fuses on the capacitor bank (D970)? - No KVact? - Error in the measurement circuit on D915? - Main inverter frequency too low? - Defect in the main inverter D960?
Err 15	**$mA_{ACT} < mA_{NOM}$** - Check the filament circuit.

Err 17	**Maximum exposure time (max. exposure time reached)** - Filament current too low? - mAs counter is set incorrectly (P1 on D915)?
Err 18	**Exposure not completed (exposure not completed by the system - exposure switch was released)** - Operator error? - Intermittent contact in the release switch? - Error in the exposure release circuit?
Err 20	**Capacitor bank not ready** Device was not ready yet / had not released yet. - F1 on D950 defect? - Error on D950?
Err 21	**Vfil > Vmax (max. filament heating exceeded during preparation)** - Error during the acquisition of the filament heating? - Basic value of the exposure filament incorrectly set (P5 on D915)? - Error on D915?
Err 22	**Maximum preparation (preparation time too long)** - Prep level pressed too long.
Err 30	**Fast capacitor charge (capacitor bank charges too fast)** - Are all fuses on the capacitor bank (D970) ok? - Are there defective capacitors? - Is the line voltage too high (> 250 V)? - Is the charging frequency too high? - Configure the capacitor bank. - D950 defect?
Err 31	**Slow capacitor charge (capacitor bank charges too slow)** - 'V25' (line) on D950 flashing? Check fuse F1 - No or insufficient charging frequency? - Check D950 ('V22 - V24' defective?) - Poor connections to/in the capacitor bank?
Err 33	**Inverter Error** - Check ribbon cable X20. - FMAX not adjusted? - IGBT short-circuited?
Err 34	**Filament Inverter short-circuit** - FMAX not adjusted? - IGBT short-circuited?
Err 90	**EPROM checksum** - EPROM defective.
Err 96	**kVnom failure (hardware error, see also Err 5)**
Err 97	**mAnom failure (hardware error, see also Err 6)**

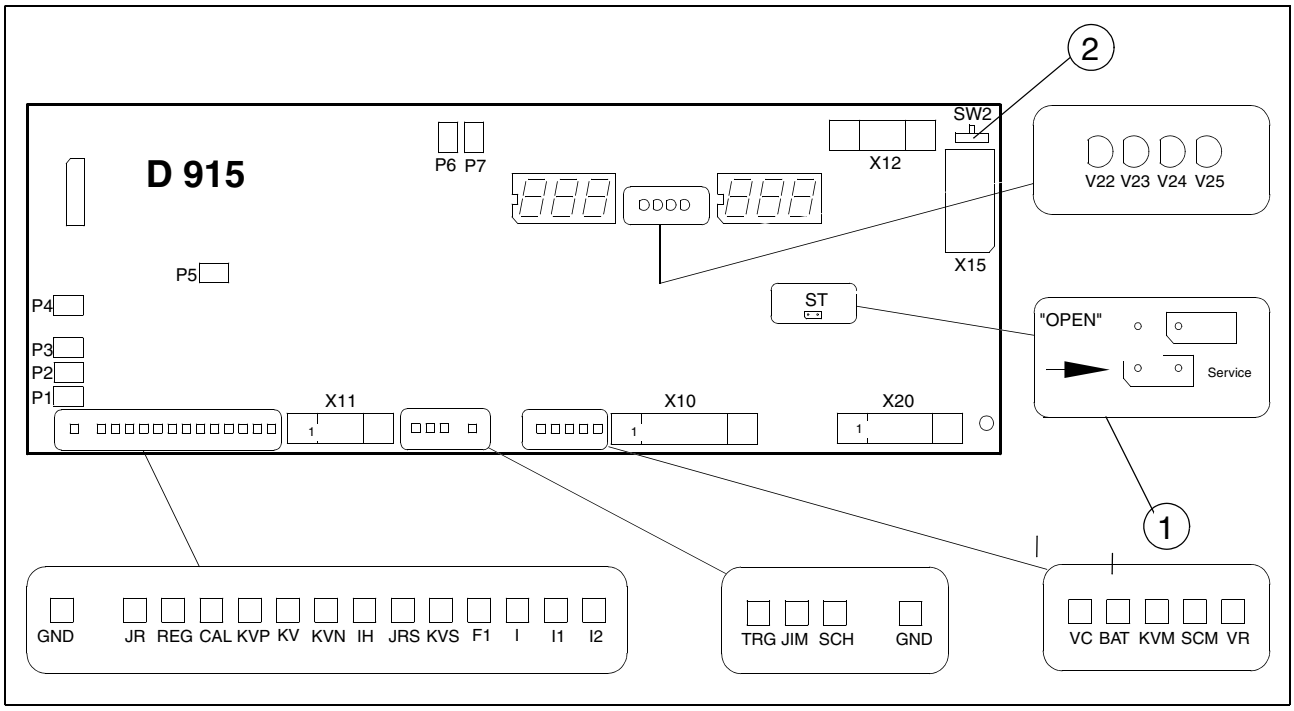


Fig. 1

To bypass the service mode, the ST slot (1/Fig. 1, below the display on D915) has to be jumpered before switching on the POLYMOBIL Plus.
As soon as "Pr. 1" appears in the display, bring the jumper back to the "OPEN" position.

KV +/-	Keys toggle between the programs. When you are already in a program, the next or previous program step is selected. Setting of the kV values in "Pr. 5" and "Pr. 6".
mAs +/-	Setting of the mAs values in "Pr. 5" and "Pr. 6".
Lamp switch	Activating or quitting the current program.

To quit the service mode, switch the POLYMOBIL Plus off/on or press the Reset button SW 2 (2/Fig. 1).

Service programs available

Pr. 1 Configures the capacitor bank.

After starting the service program, "CAP 150" appears on the display.
The voltage of the capacitor increases in increments (approx.) from 150 V to 250 V, 330 V, 400 V, 430 V up to 440 V.
The program remains at each step for about 6 minutes at the 150 V to 440 V level.
The system remains at the 440 V level for one hour after which the program automatically ends; "CAP END" appears on the display.

Pr. 2 Reads out the exposure counter.

Pr. 3 Error memory with up to 20 errors.The left display indicates how many errors occured.The error message is displayed in the right display. The latest error is displayed first.

Pr. 4 Deletes error memory.
Press mAs + key for approximately 4 seconds.

Pr. 5 Sets the default exposure parameters (according to customer request).

Pr. 6 Sets the maximum possible KV and mAs values (according to customer request).

Pr. 7 Adjusts FMAX on the main inverter.

"ADJ F" appears on the display after starting the service program.
Press S27.
"F on" appears on the display.
FMAX can be measured at TP "REG" on D 915 and can be set with potentiometer P4.

Pr. 8 Tests the anode starter unit.
Press S 27.

Pr. 9 Tests the filament unit.

"FIL 3" appears on the display after starting the service program.
Press S27.
Filament boosts; "FIL 5" appears on the display.

NOTE	**There is no radiation present during these service programs.**

Line voltage

The line voltage must be set to 110 V (± 10%) or 230 V (± 10%).
The line voltage is adjusted automatically.

Measuring KVact and Itube

- Connect the oscilloscope to TP "JR", "KV" and "GND" on D915.

CH1	TP "JR"	1.0 V/Div
CH2	TP "KV"	1.0 V/Div
		Ground at "GND"
		10 ms/Div
		Trigger external at TP "TRG"

- Set 90 kV and 10 mAs at the POLYMOBIL Plus and release an exposure.
  The oscillogram should correspond to that shown in Fig. 1.

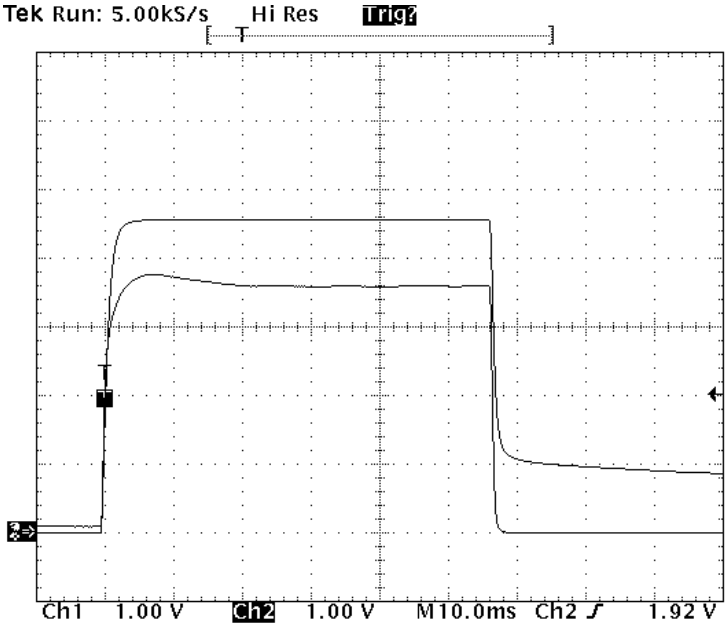


Fig. 1

Capacitor charging circuit

NOTE	Signals are only present during charging of the capacitors.

Charging frequency

- Connect the oscilloscope to D 950 at TP "FR1" and "GND".

  CH1 TP "FR1" 5.0 V/Div
  Ground at "GND"
  20 µs/Div

- After switch on, the following oscillogram can be measured:

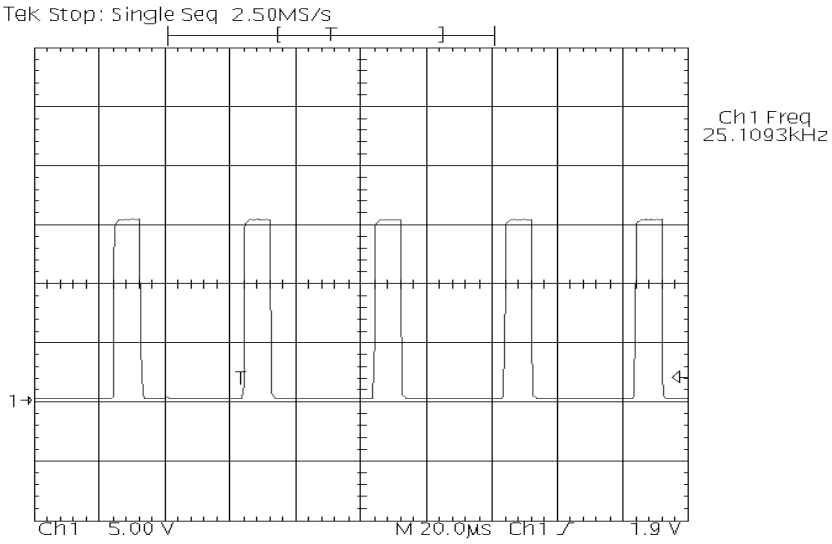


Fig. 2

The capacitor charging frequency is 25 kHz and cannot be adjusted.

Capacitor charging current

- Connect the oscilloscope to D 950 at TP "IC" and "GND".

CH1	TP "IC"	500 mV/Div Ground at "GND" 20 µs/Div

- After switch on, the following oscillogram can be measured:

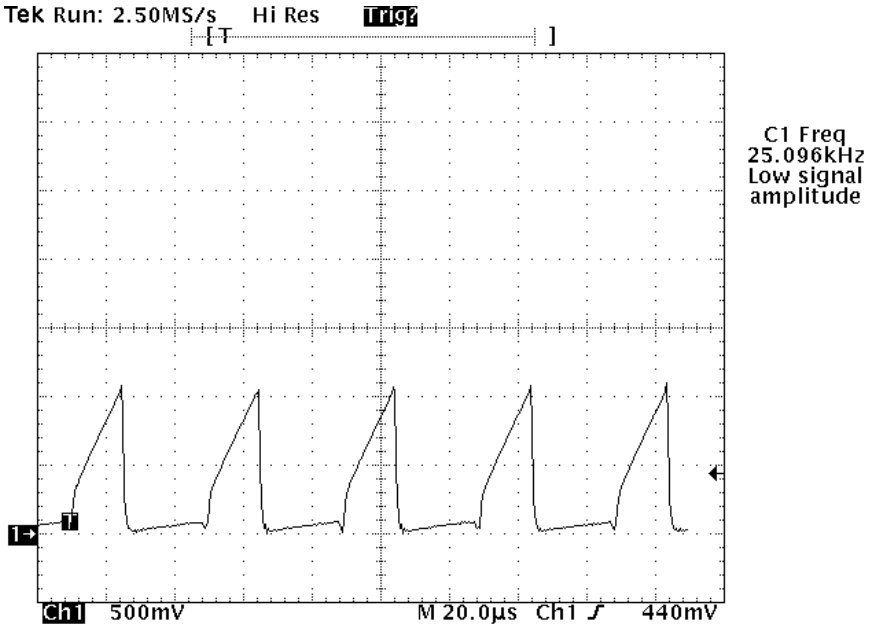


Fig. 3

The charging current depends on the line voltage present and on the charge status (capacitor voltage U_C) of the capacitor bank.
Fig. 3 shows the charging current in standby, i.e. when the C-bank is charged.

Capacitor voltage (Uc) and charging time

In exposure-ready status, the capacitor voltage is approximately 440 V and can be measured on D 950 TP "VC".
If the device is switched off because of overvoltage, the signal "ERR" is output on D950

⚠WARNING

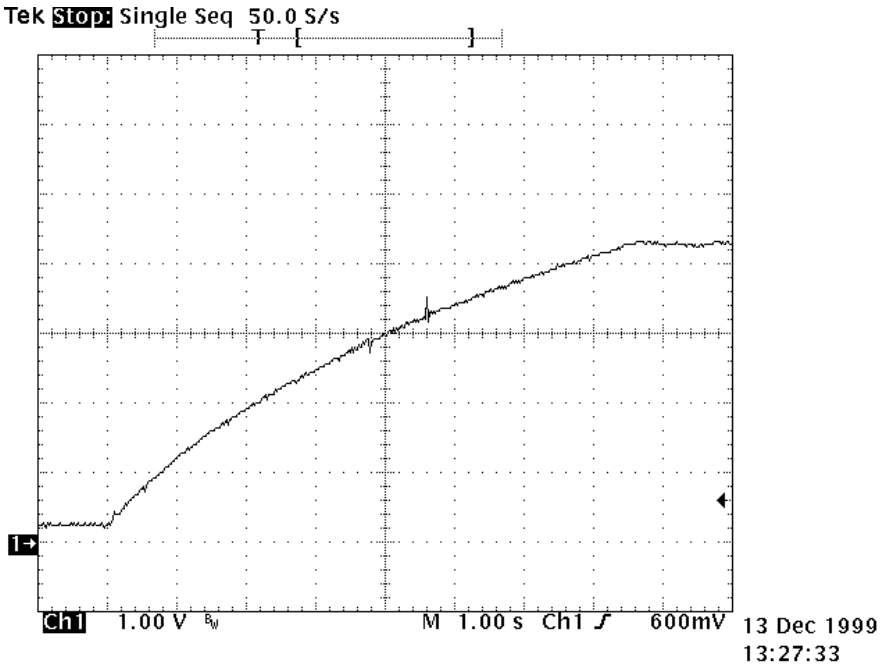
When working on the open system, there is a danger of Electric shock !

Risk of death or serious physical injury.

You can measure the capacitor voltage at TP "VC" only if POLYMOBIL Plus is switched on.

The charging time depends upon the residual charge of the capacitor bank and on the available line voltage, e.g. with 230 V the max. charging time is about 15 s.
In the worst case, (line voltage <100 V and residual charge = 0 V), the charging time can be 40 seconds.

For the following measurement, the line voltage was 230 V and the residual charge 30 V.



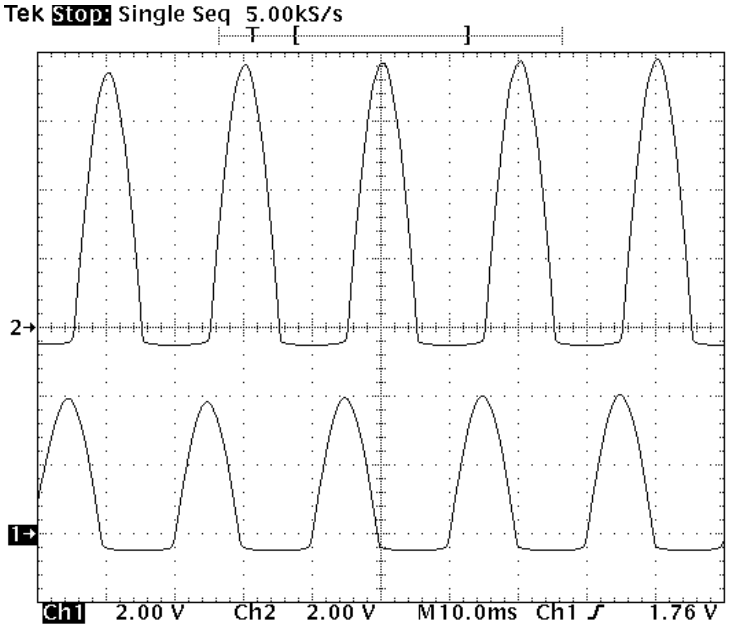
D915 test point "VC" (1 V ≙ 100 V)

Fig. 4

Rotating anode starter

Acceleration

Fig. 5 shows the stator currents during rotating anode acceleration (230 V).



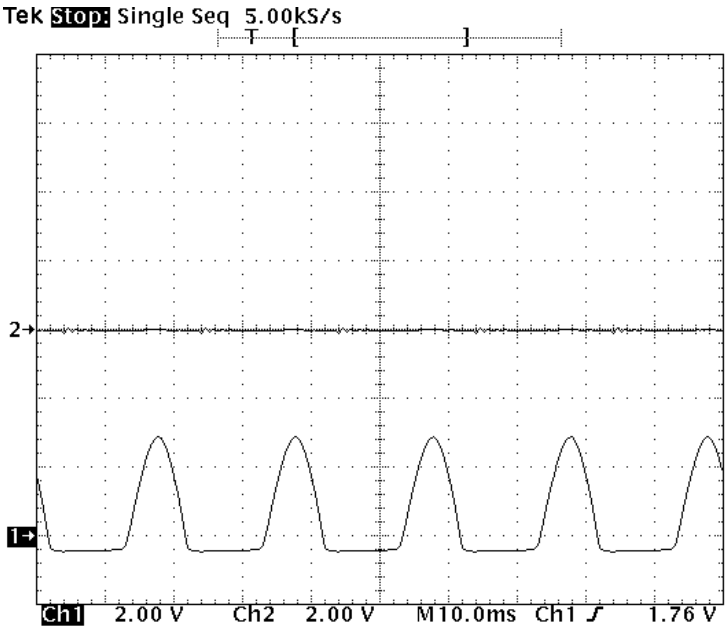
CH2 D915 test point "I1" (1 V ≙ 0.25 A)
CH1 D915 test point "I2" (1 V ≙ 0.25 A)
10 ms /Div

Fig. 5

NOTE	**The currents are correspondingly lower at 100 V line voltage.**

Brakes

Fig. 6 shows the stator currents during braking (230 V)



CH2 D915 test point "I1" (1 V ≙ 0.25 A)
CH1 D915 test point "I2" (1 V ≙ 0.25 A)
10 ms /Div

Fig. 6

NOTE	**The currents are correspondingly lower at 100 V line voltage.**

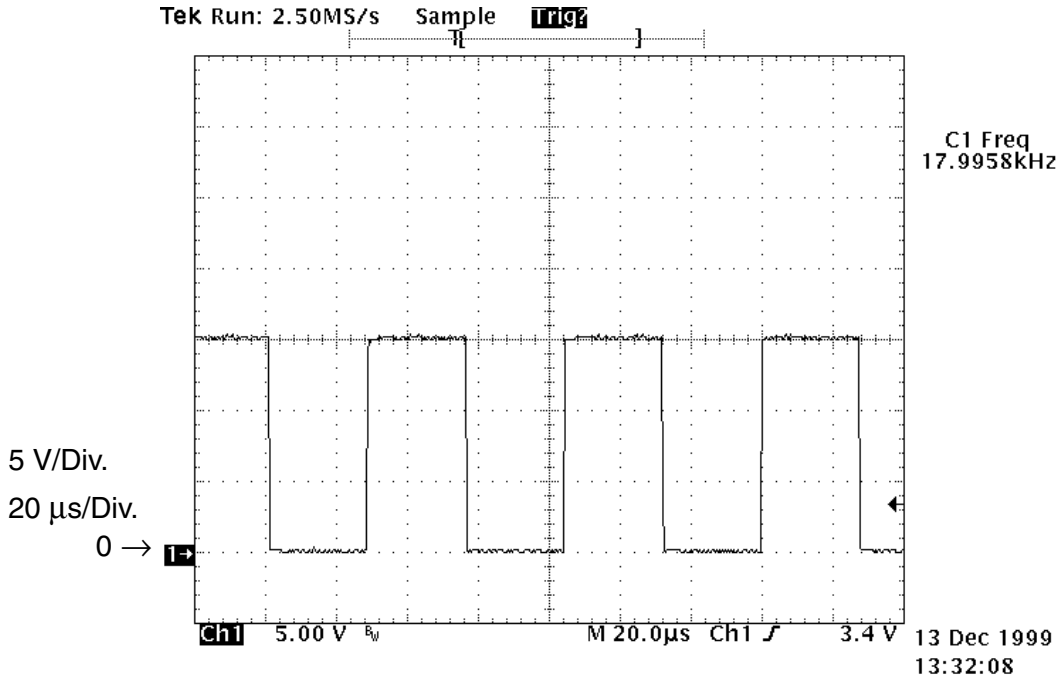
kV Control

Checking the maximum main inverter frequency

NOTE

It is generally not necessary to set the main inverter frequency in the field. When ordered as a replacement, D915 is preset at the factory.

- Connect the oscilloscope to D915 at TP "REG" and "GND".
- Measure F_{MAX} in the service program Pr. 7
  (See "Service program", section on "Service programs available")



F_{MAX} = 18 kHz

T_{MIN} = 55.5 µs Tolerance: -1.5 µs /+1.5 µs

Fig. 7

- Setting the maximum main inverter frequency with potentiometer P4 on D 915.

Measuring the oscillating current

⚠WARNING

When working on the open system, there is a danger of

Electric shock !

Risk of death or serious physical injury.

Prior to beginning the following instructions, you must discharge the capacitor bank because life-threatening DC voltage is present. Check the actual charge with the DVM.

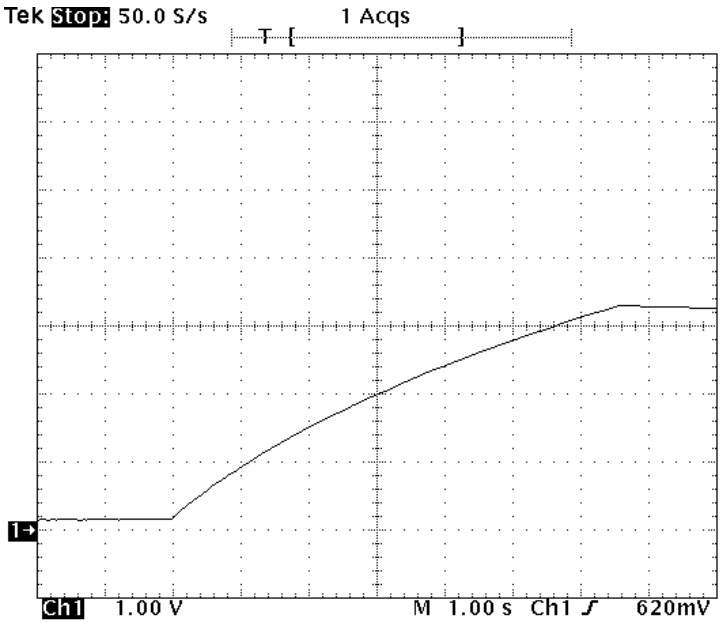
- Switch **OFF** POLYMOBIL Plus and wait until the capacitor voltage has dropped to a value < 10 V.
- Disconnect the cable from the inverter to capacitor C1. Push the cable through the current transformer 50 A : 50 mA (with a parallel resistor of 10 ohms) and reconnect the cable.
- Connect the oscilloscope to the current transformer.
- Switch **ON** POLYMOBIL Plus.
- Set 60 KV, 10 mAs on POLYMOBIL Plus and release exposure.

The diagram must correspond to Fig. 8.

NOTICE

Maximum main inverter frequency

The maximum main inverter frequency can only be measured in the ascending part of the high voltage, i.e. in the first microseconds, because afterwards the frequency is lower.



CH2: 1 V/Div, Trigger: Test point "TRG" external on D 915
20 µs /Div

Fig. 8

Measuring the kVact and kVnom

- Connect the oscilloscope to D915 at TP "KV", "KVS" and "GND".
- Set 60 KV, 10 mAs on POLYMOBIL Plus and release exposure.
- The oscillogram must appear as shown in Fig. 9.
- The KVnom value can be set with P7 on D915.

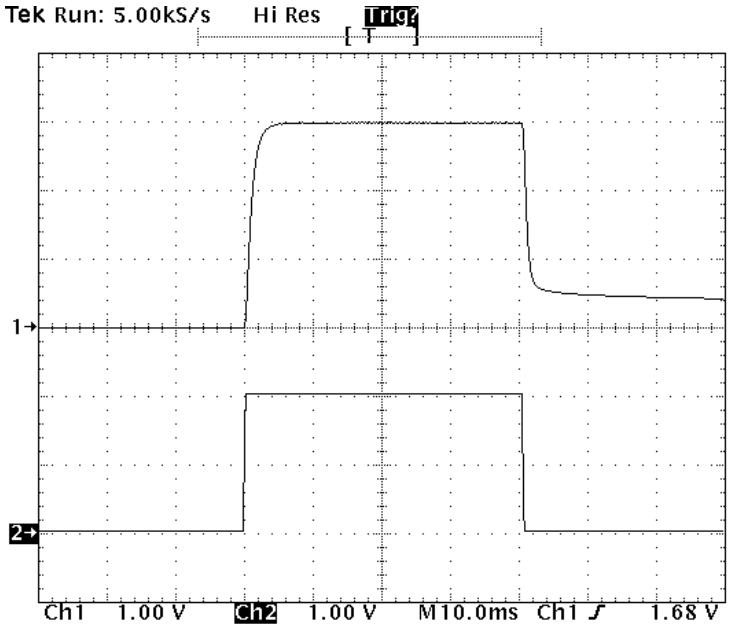


Fig. 9

kVact: CH1 D915 test point "KV" 1 V ≙ 20 KV
kVnom: CH2 D915 test point "KVS" 1 V ≙ 30 KV
20 ms /Div

Error in the kVact acquisition

Fig. 10 shows that one kVact cable from the single tank generator to the D915 is damaged or disconnected.
The monitor (KVM) responds (curve 3) because KVN and KVP have different amplitudes; the exposure is terminated with ERR 12.
Refer to function description "KV monitoring".

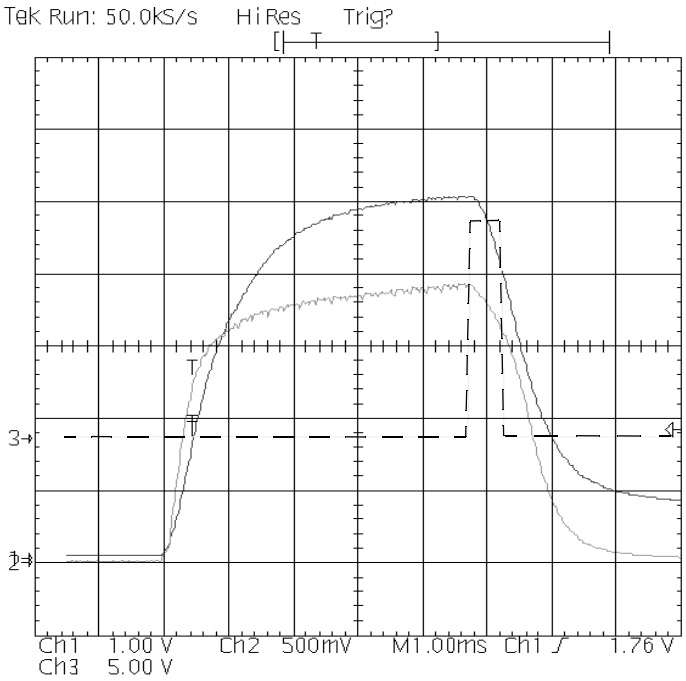


Fig. 10

Exposure data: 102 KV 10 mAs

KVact: CH1: D915 test point "KV"
Itube: CH2: D915 test point "JR"
CH3: D915 test point "KVM"
1 ms /Div

Testing the filament circuit

Filament circuit in standby

- Connect the oscilloscope to D915 at TP "CAL", "I" and "GND".

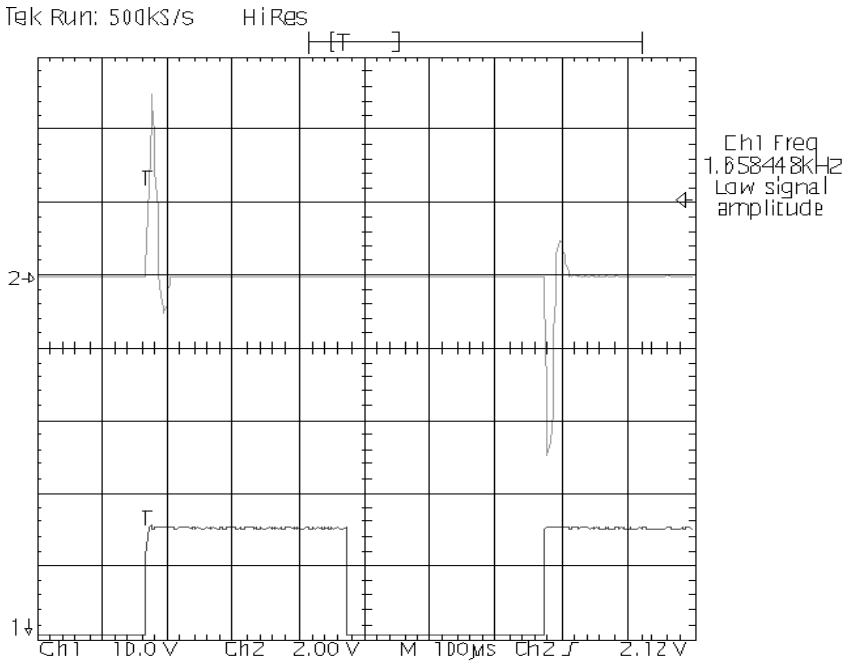


Fig. 11

Filament inverter frequency	CH1: D915 test point "CAL"
Filament current	CH2: D915 test point "I"

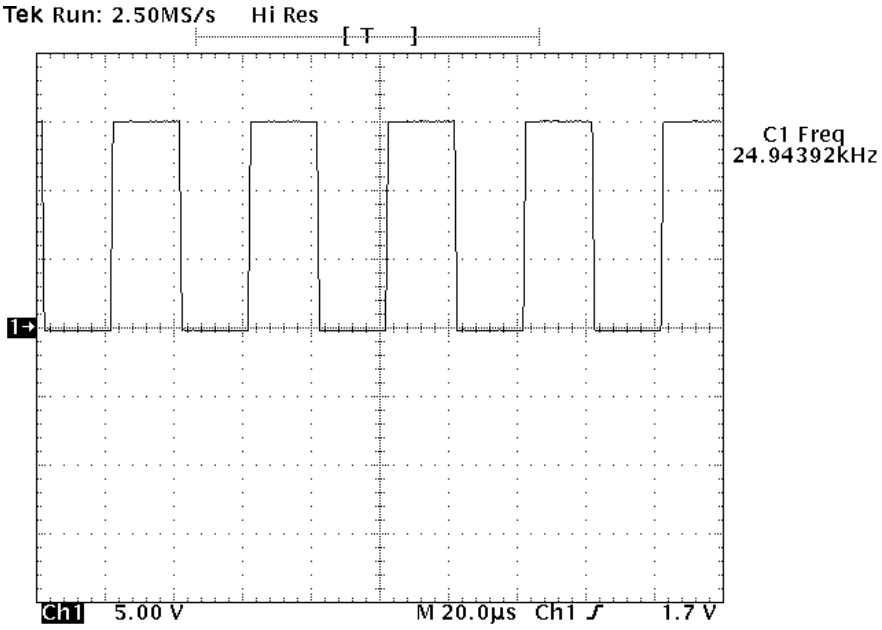
Setting the maximum filament inverter frequency

The maximum filament inverter frequency is 25 kHz and can be set with P3 on D915.

Proceed as follows:

- Switch POLYMOBIL Plus **OFF**.
- Remove fuse F6 on D925.
- Connect the oscilloscope to D915 at TP "CAL" and "GND".
- Switch POLYMOBIL Plus **ON** (Err 03 is blinking).

The oscillogram must appear as shown in Fig. 12.



CH1: D915 test point "CAL"
20 µs /Div

Fig. 12

- Setting the maximum filament inverter frequency with potentiometer P3 on D915.

Measuring the filament nominal value

The filament nominal value is set at the factory and should not be changed.

The filament nominal value can be measured on D915 at TP "JRS" and "GND" with the DVM and is 1.5 V ± 4% in standby.

NOTE	**If this value is changed, the nominal values for preparation and exposure are also affected.**

Setting the tube current for the exposure

The tube current must be reset for each tube.

Proceed as follows:

- Connect the oscilloscope to D915 at TP "JR", "IH" and "GND".
- Set 60 kV, 10 mAs on POLYMOBIL Plus and release an exposure.

The oscillogram must appear as shown in Fig. 13.

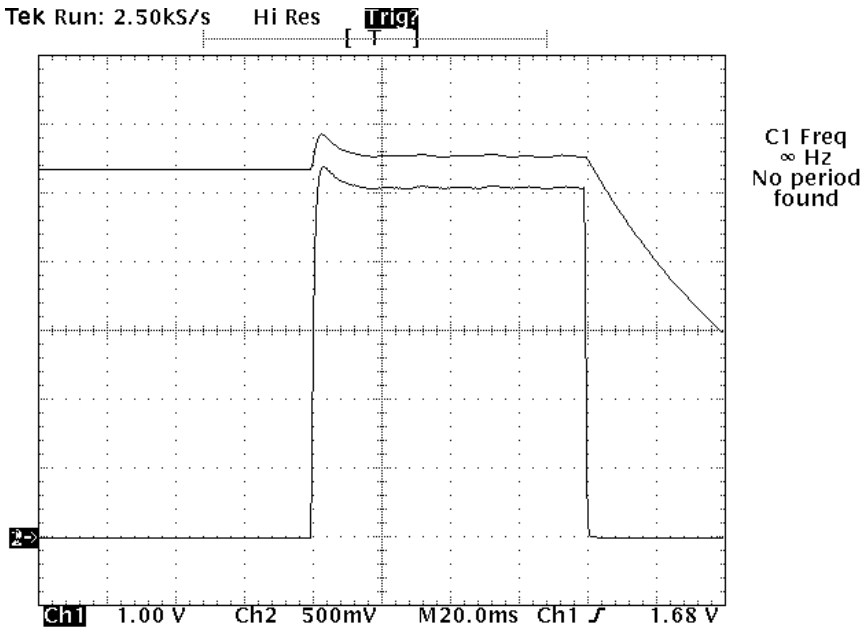
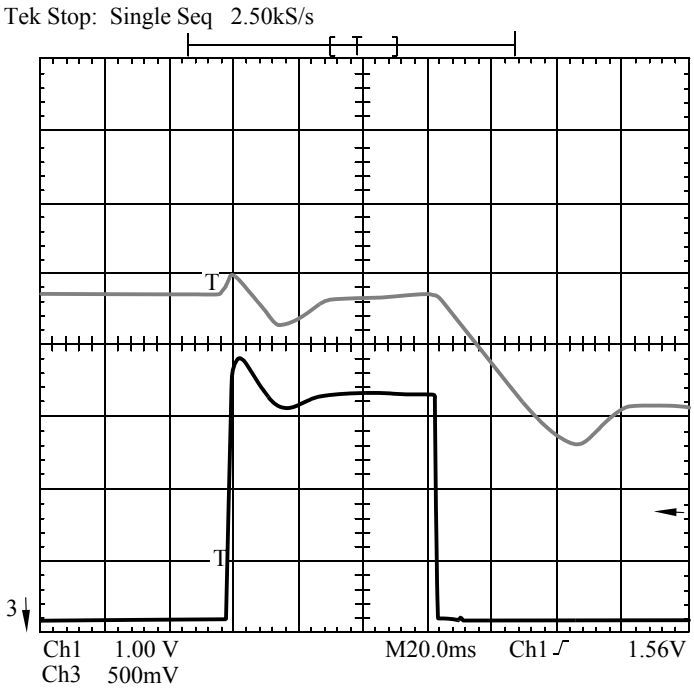


Fig. 13

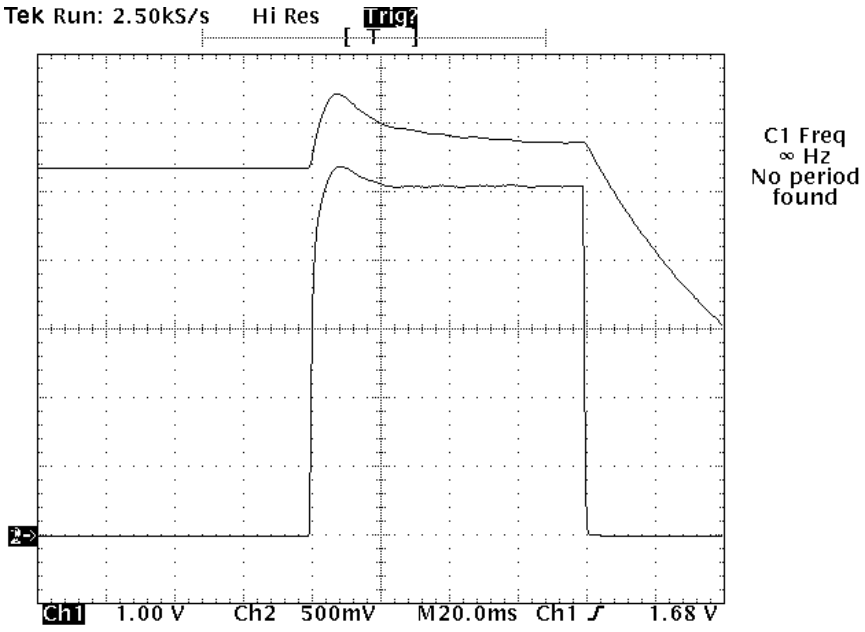
Actual tube current value CH1: D915 test point "JR"
Actual fil. current value CH3: D915 test point "IH"

If this is not the case, adjust P5 on D915 until there is minimal current overshoot at the beginning of the exposure.
The standby heating of the exposure is set via P5 (IH ↓ , ↑ IH).
Fig. 13 shows the correct setting.
In Fig. 14 the standby heating is set too high.
In Fig. 15 the standby heating is set too low.



Standby heating too high

Fig. 14



Standby heating too low

Fig. 15

Testing and setting the mAs counter

- Unscrew the lid of the single tank cover.
- Pull out the mAs jumper on D900 and connect the mAs meter.

- Set 70 kV, 80 mAs on POLYMOBIL Plus and release exposure.

If the value displayed on the mAs meter does not coincide with the value set on POLYMOBIL Plus, adjust the mAs counter with P1 on D915.

Release another exposure and compare the display.

⚠CAUTION

Overheating of the tube during radiation.

If not observed the tube can be damaged.

Observe the cooling intervals for the tube.

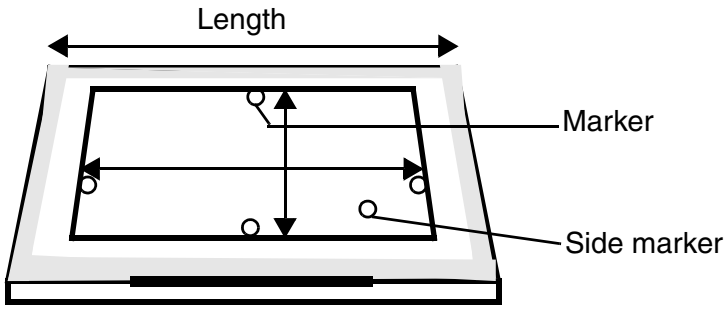


Fig. 16

Coincidence of light and radiation fields

NOTE	**If the POLYMOBIL is equipped with a DAP measuring system, remove the DAP ionization chamber first.**

Procedure:

- Insert film into the 24 cm x 30 cm or 10” x 12” cassette and place it on a table or similar surface.
- Adjust the vertical SID of 100 cm or 40” to the top edge of the cassette using a measuring tape.
- Use the knobs to set a format of 18 cm x 24 cm or 8” x 10”.
- Switch on the light localizer and align the cassette.
- Apply radiopaque markers (e.g. washers, coins) as shown in Fig. 16.
  Use one washer as a side marker.

- Release an exposure (60 kV, 10 mAs) and develop the film.
- Log the following data on the developed film using a water-resistant felt-tip pen.
  - SID setting
  - Film size
  - Radiation field size

Evaluation:

- Measure the deviations (X1, X2, Y1, Y2) between the edges of the light field and the radiation field on all four sides, corresponding to Fig. 17.
- Calculate the total deviations in the X and Y directions (disregarding the algebraic sign).

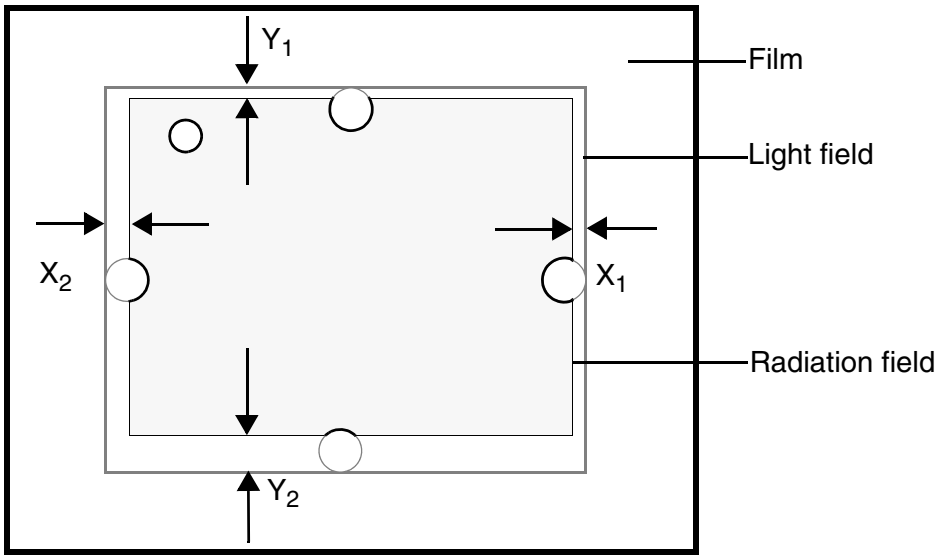


Fig. 17

- The deviations in length (total Y) as well as the deviations in width (total X) must be smaller than 1.6 cm respectively.

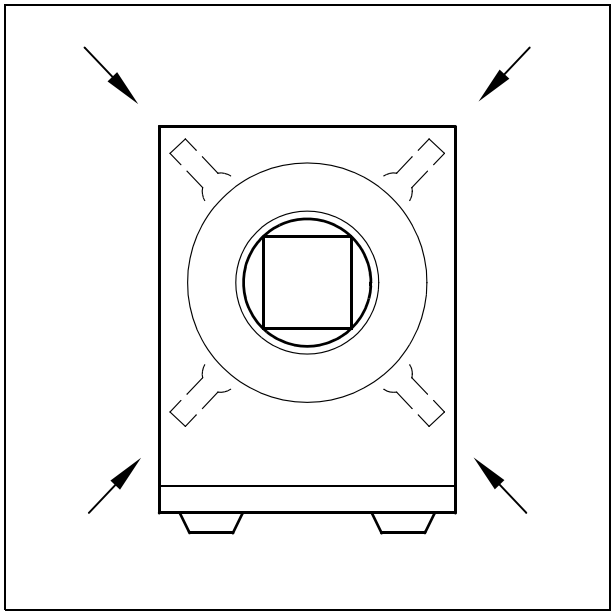


Fig. 18

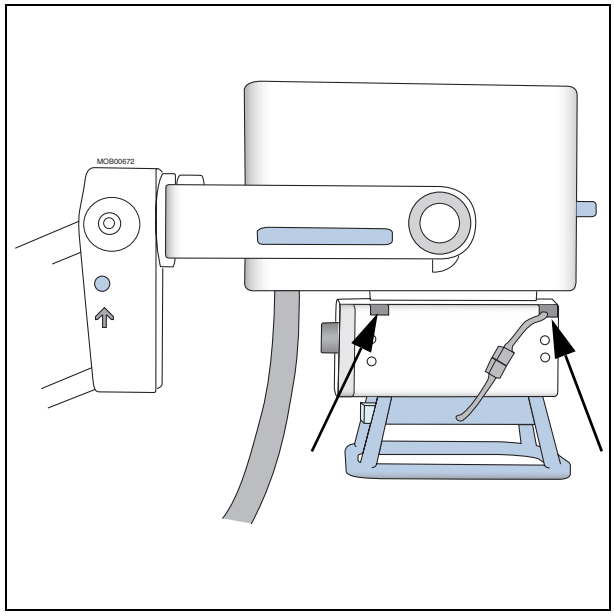


Fig. 19

- If the deviation is larger, loosen the four Allen screws a little (arrow/Fig. 18/Fig. 19) and shift the collimator accordingly.
  After adjusting the collimator, tighten the screws again (arrow/Fig. 18/Fig. 19).
- Repeat the test and readjust the collimator until the light and radiation fields are within the acceptable tolerance (< 1.6 cm).

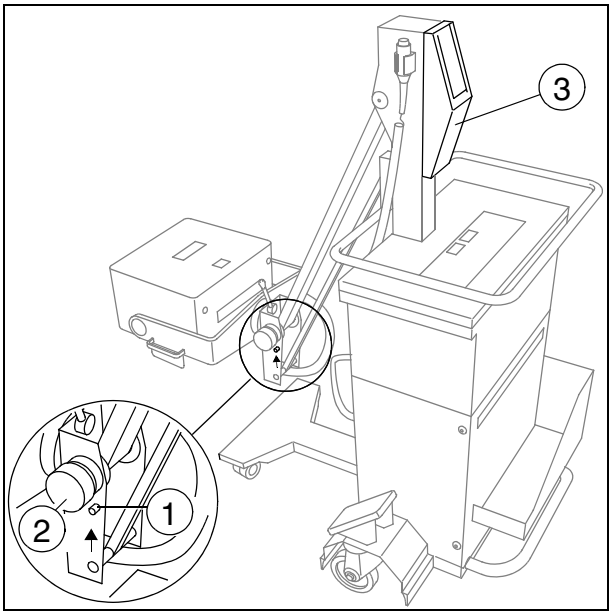


Fig. 20

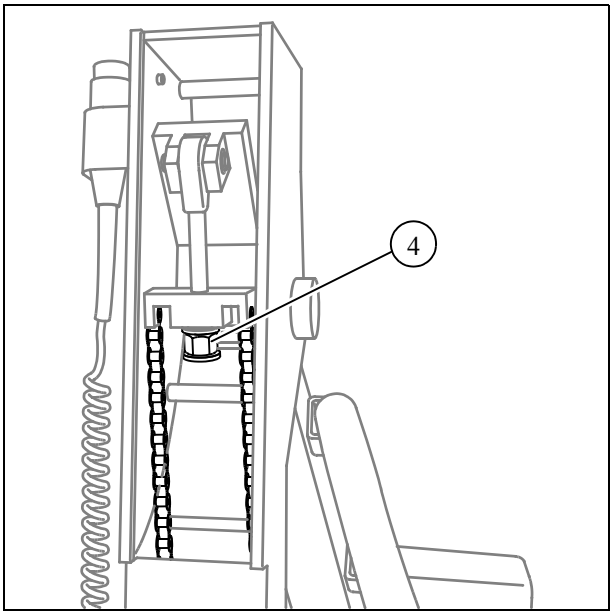


Fig. 21

Testing and readjusting the counterbalance

- Loosen the rotating knob (2/Fig. 20) and unlock the C-arm (1/Fig. 20).
  It should be possible to move the C-arm without any attached accessories easily across the whole range and the arm should come to a stop in any desired position.

Readjusting the counterbalance with accessories attached

If the C-arm with accessories attached does not come to a stop in any desired position, readjust the spring tension for the counterbalance.

- Remove the cover (3/Fig. 20) at the stand.
- Release the supplemental brake at the C-arm (2/Fig. 20) completely.
- Move the C-arm into a vertical position.
- Tighten the screw using a 17 mm Allen key (4/Fig. 21).
  Adjust the spring tension in such a way that there is a balance when the C-arm is in a vertical position, i.e. that equal force is required to lift and lower the tube assembly.

NOTICE

To repair paint chips, the POLYMOBIL Plus colors can be ordered in spray cans:

"white" spray paint	**84 27 734**
"ergo gray" spray paint	**84 27 742**
"medical blue" spray paint	**55 07 046**

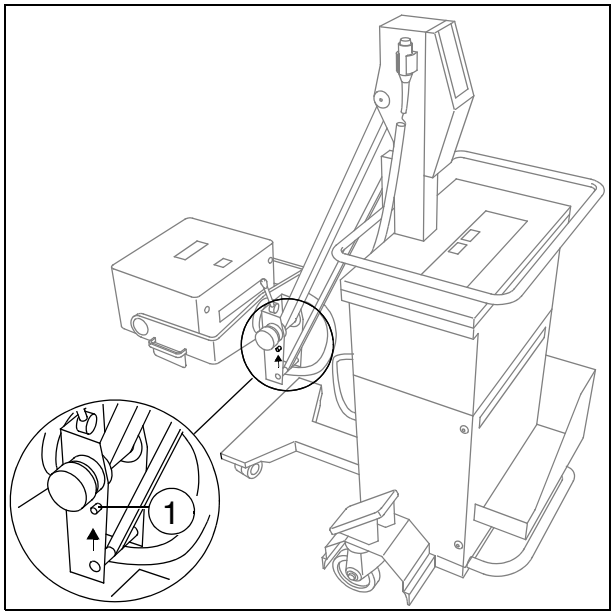


Fig. 1

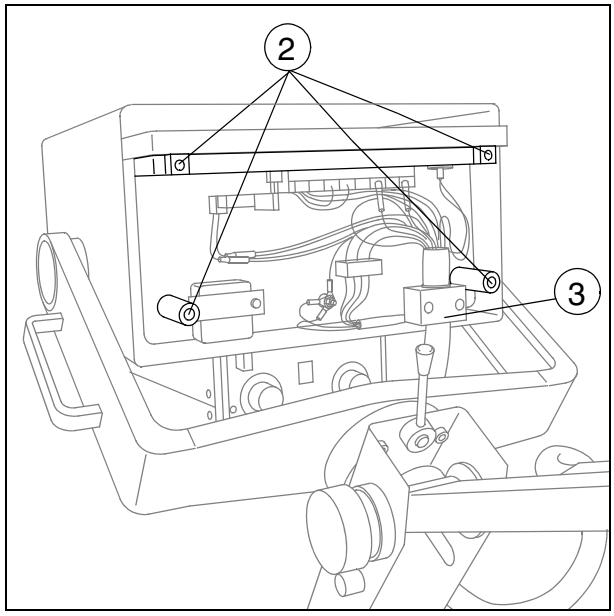


Fig. 2

Replacing the single tank generator

To replace the single tank generator, remove it from the stand as described below:

- Remove the collimator (see “Replacing the collimator”).
- Move the arm into the lowest position and check whether the safety mechanism (bolt 1 / Fig. 1) is locked into position.
  Now the stand cannot be moved upwards.
- Remove the four Allen screws of the single tank generator cover (2/Fig. 2), remove the cover, disconnect the connections and the strain relief of the corrugated tubing (3/Fig. 2) and remove it.

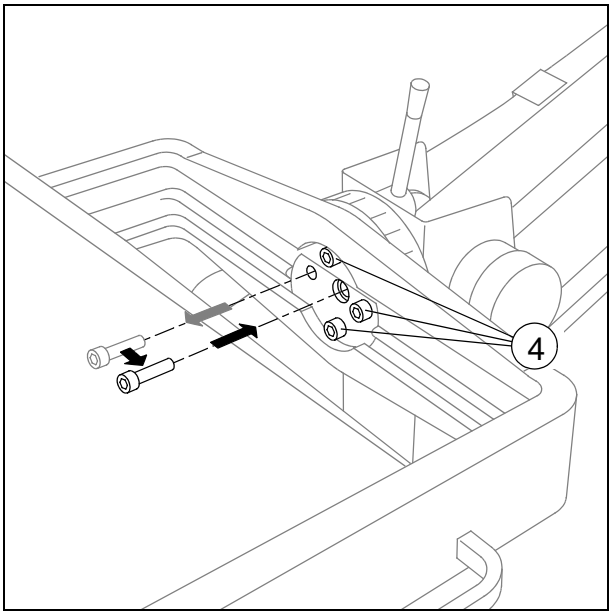


Fig. 3

- Take out one of the four mounting screws and insert it into the threaded hole and tighten it (arrow/Fig. 3).

⚠WARNING **Accurate usage of safety device for the arm of the unit.**

If not observed, death or serious physical injury can occur.

This is a safety device (see arrow/Fig.03) to prevent the arm of the unit from flying upward if the lever for the transport lock is inadvertently activated.

- Place a pad under the single tank generator.
- Disconnect the single tank generator together with the bracket from the stand by removing the three remaining screws (4/Fig. 3).
- Lower the single tank generator to the pad.
- The single tank generator is installed in reverse sequence.
  - Secure the three mounting screws (4/Fig. 3) with Loctite 242 and tighten them.
  - Remove the fourth mounting screw from the threaded hole (arrow/Fig. 3) and reinstall it in its former position. Secure the screw with Loctite 242.
  - Test the torque of the mounting screws;
    Nom: 25 Nm, Tolerance ± 10%.
- Reinstall the collimator in reverse sequence.
- Set the tube current (see "Setting the tube current for the exposure", page 5-13).
- Check the coincidence of the light and radiation fields and adjust, if necessary (see "Coincidence of light and radiation fields", in chapter 5)

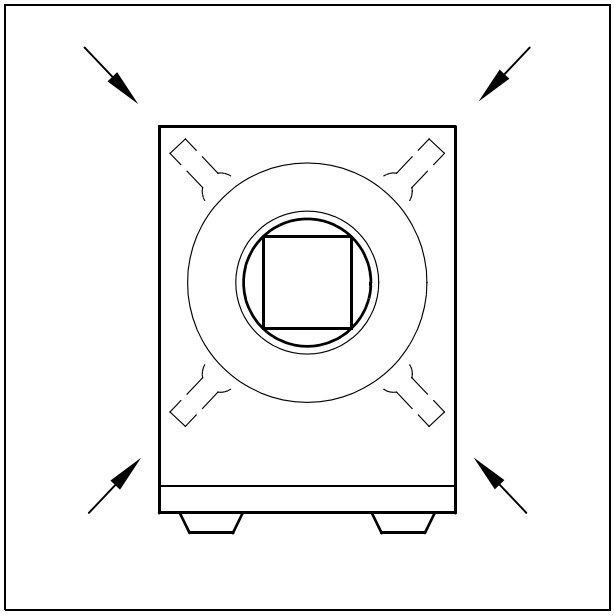


Fig. 4

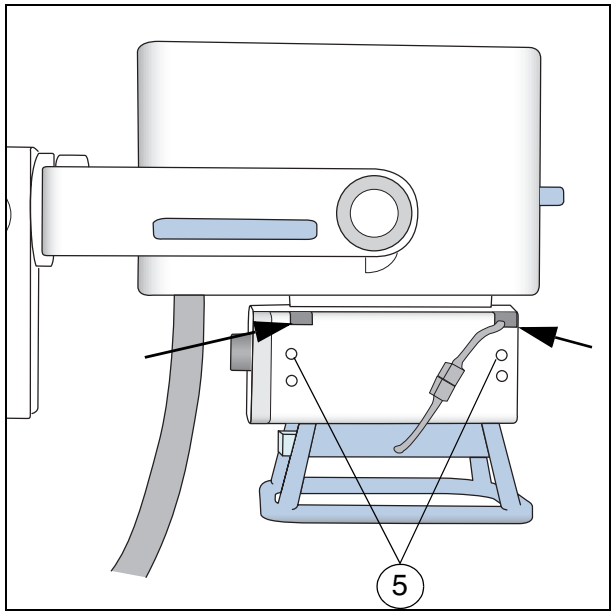


Fig. 5

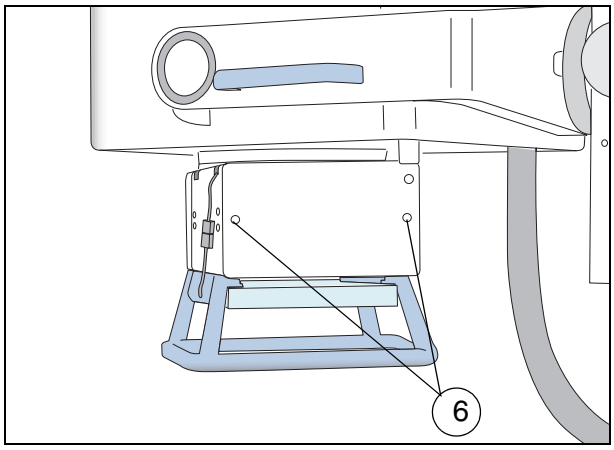


Fig. 6

Replacing the collimator

In case of damage, the collimator has to be completely replaced.

Proceed as follows:

- Remove the two screws (6/Fig. 6) and remove the back panel.
- Mark the five connecting cables of the collimator and disconnect them.
- Remove two screws on each side (5/Fig. 5) of the upper cover.
- Turn the two knobs to the end position and remove them.
- Remove the front panel after you have removed the two screws (7/Fig. 7).
  Caution: The front panel is connected to the collimator via a cable (9/Fig. 8).

- Remove the collimator after removing the four Allen screws (arrow /Fig. 4-Fig. 5).

⚠CAUTION **Accurate replacement of the collimator**

If not observed, the collimator can be damaged.

Hold the collimator securely.
Lift the upper cover and pull the cable through the housing.

- Attach the new collimator with the four screws (arrow /Fig. 4-Fig. 5) and center it.
- Reconnect the cables and the back panel.
- Check the coincidence of the light and radiation fields and adjust, if required.
(See “Coincidence of light and radiation field”, page 5-16.)

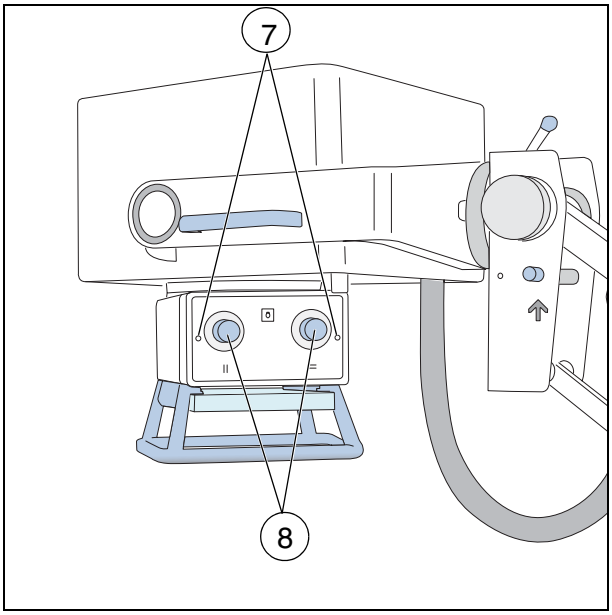


Fig. 7

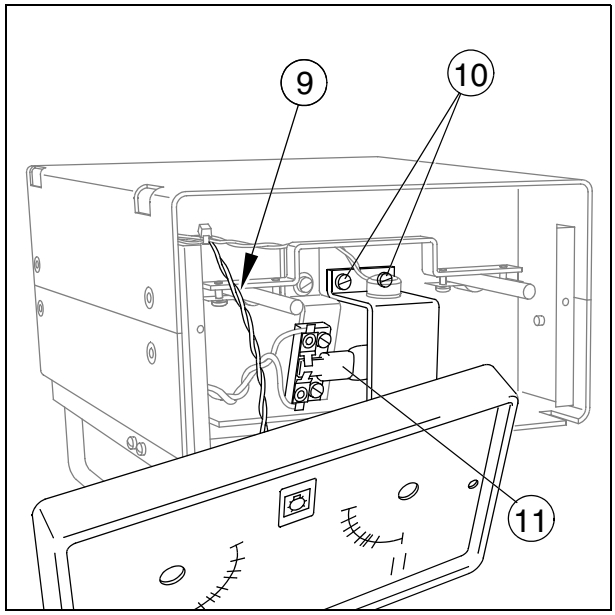


Fig. 8

Replacing the lamp for the localizer

- The replacement light localizer lamp is located below the cassette module.
- Turn both knobs (8/Fig. 7) to the end position and remove them.
- Remove the front panel after removing both screws (7/Fig. 7).
Caution: The front panel is connected to the collimator via a cable (9/Fig. 8).
- Remove both screws (10/Fig. 8) and take off the metal bracket for the temperature switch).
- Take out the defective lamp (11/Fig. 8) and replace it with a new lamp

NOTICE **Danger of burn-in by fingerprint.**

Do not touch the glass envelope with your fingers.

Use a fluffless cloth during the replacement of the lamp.

- Attach the bracket and the front panel.
- Adjust both knobs and attach them.
- Check the function of the light localizer lamp.
- Check the coincidence of light and radiation fields (see "Coincidence of light and radiation fields" in chapter 5).

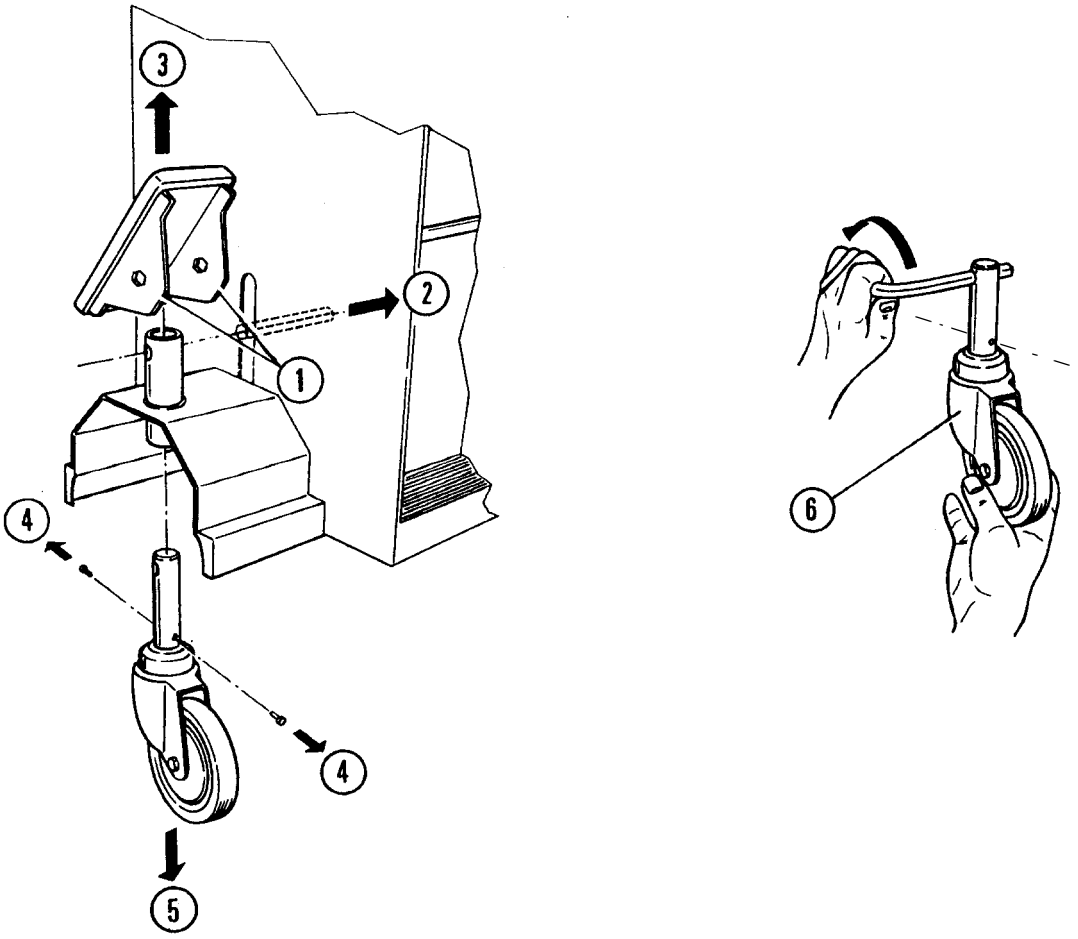


Fig. 9

Replacing the steering caster

Step:

1 **Loosen only** Allen screws on the left and right (2.5 mm wrench.
2 Pull back hexagonal shaft
3 Remove pedal
4 Remove Allen screws (wrench size 6 mm).
5 Pull out the caster.
6 Align the threaded holes on the new caster.

- Install in the reverse sequence.
- Test the pedal positions (see Operating Instructions).

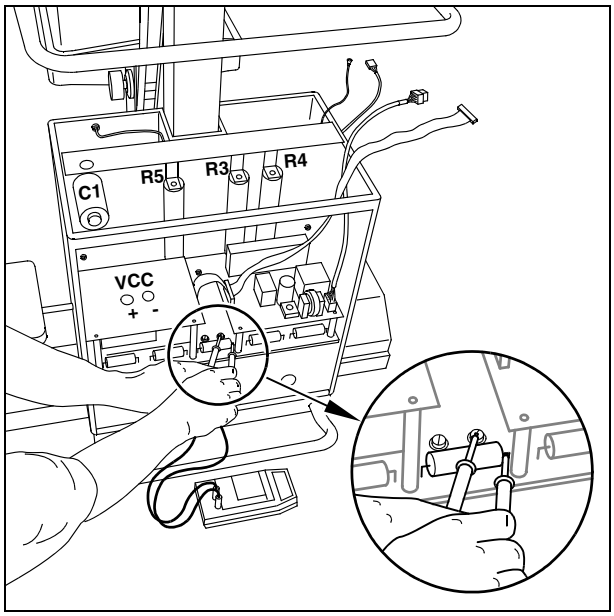


Fig. 10

Replacing the capacitor bank

⚠DANGER

When working on the open system, there is the danger of

<u>Electric shock</u> !

Contact with current-carrying parts will lead to death or to serious physical injury.

- **The capacitor bank can still be charged.**
  Do not attempt to work on the system while this condition exists.
- **For details see chapter "Prerequisites".**

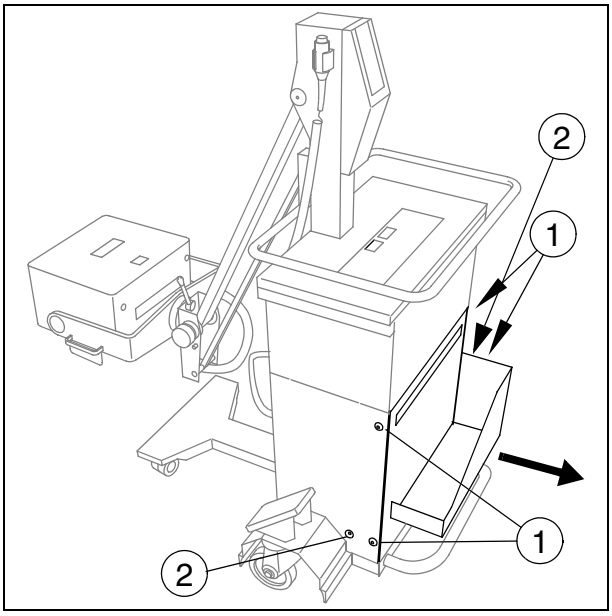


Fig. 11

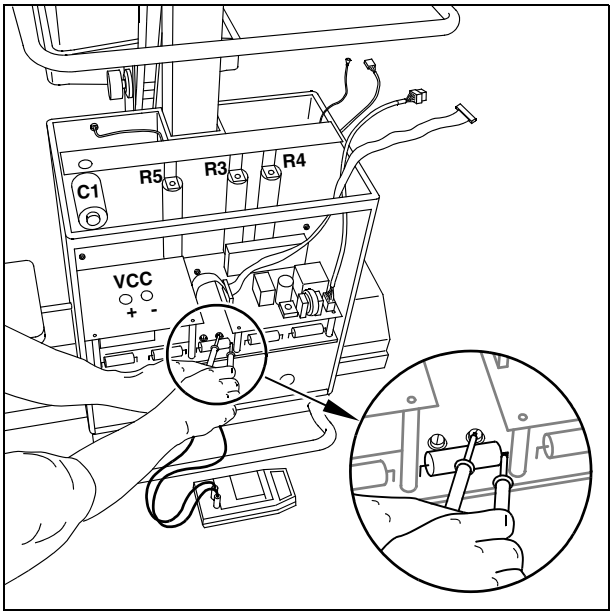


Fig. 12

- Switch the unit off; disconnect the line voltage plug;
- Remove the two cover screws on each side (1/Fig. 11) and remove the cover (with cassette drawer).
- Measure the actual voltage present in the capacitor bank with the DVM at test point - VCC and +VCC on the inverter board D960 or (more accessible) on the capacitor board D970 at the + connecting point of the C3 capacitor and on the right-hand side of fuse F3 (see Fig. 12).
-

⚠DANGER

Danger of <u>Electric shock</u> !

Contact with current-carrying parts will lead to death or to serious physical injury.

- **Continue work only if the capacitor unit is discharged (U < 10 V)**

- Remove one cover screw on each side (2/Fig. 11).
- Unscrew the three Allen screws (2/Fig. 12).
- Pull out the connectors X3 and X9 (3/Fig. 12) on the charging board D950.
- Remove flat ribbon cable X20 (4/Fig. 12) from the inverter board D960 and from the charging board D950.
- Disconnect and remove the cables of oscillating circuit capacitor C1 and oscillating circuit coil L1 to inverter board D960.
- Pull the entire capacitor unit out towards the front.

⚠DANGER

Danger of Electric shock !

Contact with current-carrying parts will lead to death or to serious physical injury.

- **If a fuse on D970 is defective, high voltage may still be present at the affected capacitor.**
- **In this case, discharge the affected capacitor with the discharging resistor R5 (Fig. 12).**

- Assembly is performed in the reverse sequence.
- Check the capacitor voltage (Uc) and the charging time (see "Capacitor voltage (Uc) and charging time ", page 5-4)

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Recalibration of DAP measuring system

This chapter shows how to recalibrate the DAP measuring system by using an external ionization chamber (dose meter).

Required equipment

- Dose meter
- Calibration tool for DAP measuring system

Recalibration procedure

- System OFF.
- Disconnect the DAP ionization chamber connectors (pos. 1 / Fig. 1).

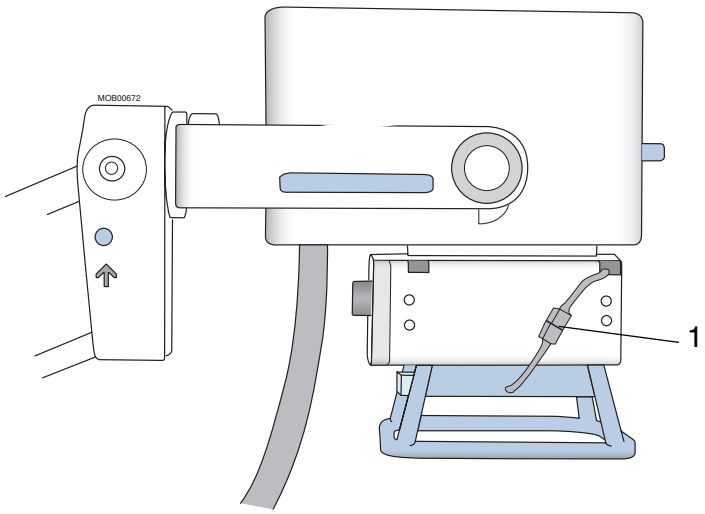

Fig. 1 Connector

- Connect the DAP calibration tool between both of the connectors that just were disconnected.

NOTE **It is irrelevant which connector is the input or the output of the DAP calibration tool.**

- System ON.
- Set up the POLYMOBIL and the dose meter as shown in Fig. 2.

NOTICE **Measurement errors.**

If a semiconductor detector is used, the temperature/pressure factor of the dose meter must be considered.

Otherwise a deviation against the factory calibration may occur.

- Switch the collimator light on. The dose meter should be positioned in the center of the light field and freely in the air to avoid back scattering radiation.

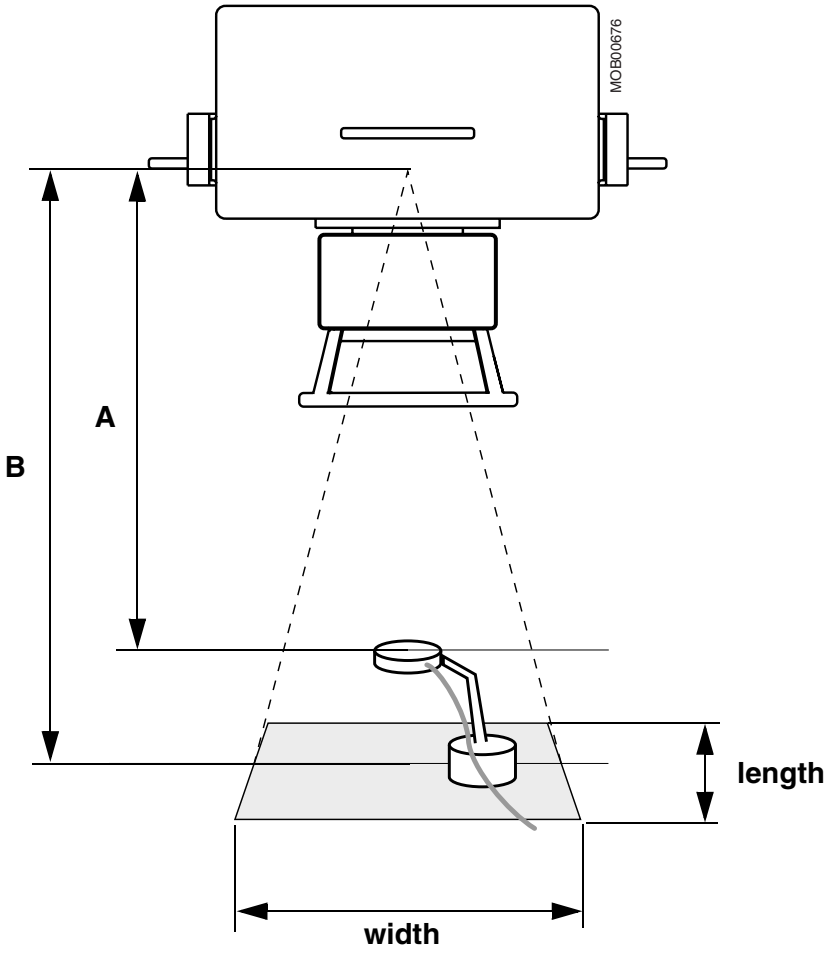

Fig. 2 Setup

- Measure the Focus - dose meter distance (**A** / Fig. 2) and then the **width** and the **length** of the light field on the surface. For optimal accuracy, place an unexposed film cassette on the surface, and measure the exposed area width and length on the film after an exposure has been released.
- Measure the Focus-light field/surface distance (**B** / Fig. 2).
- Calculate the reference area according to the following formula:

$$\text{Reference area} = \frac{A^2}{B^2} \cdot (\text{width} \cdot \text{length}) \quad (\text{unit } m^2)$$

- Set kV to 102 and mAs to 20 and release an exposure.
- Record the dose value measured with the dose meter.

- Calculate the reference DAP value using the measured dose value according to the following formula:

$$\text{Reference DAP value} = \text{measured dose value} \cdot \text{reference area} \quad (\text{unit } \mu\text{Gy m}^2)$$

- Record the DAP value measured with the DAP measuring system (DAP value from display).
- Calculate a comparison with the following formula:

$$\text{Comparison value (\%)} = \frac{100 \cdot \text{DAP value from display}}{\text{Calculated DAP value}} - 100$$

The comparison value shows the deviation between the actual DAP value (measured with the dose meter) and the DAP value measured with the DAP measuring system. If the comparison value is negative, the DAP display shows a value that is lower than the actual value, and vice versa.

If the comparison value is less than ±5%, the calibration is completed.

- To correct the deviation, press the “UP” button on the calibration tool (for negative comparison values) or the “Down” button (for positive comparison values). Pressing a button once corresponds to approximately 0.5 % change of the comparison value.

NOTE	**The middle push-button on the DAP calibration tool is for test purposes. It has the same function as the test button on the DAP display.**

- Repeat the calibration sequence until the deviation is less than ±5 %.
- System OFF.
- Remove the DAP calibration tool and reconnect the DAP ionization chamber as shown in (pos. 1 / Fig. 1).
- System ON.
- Press the reset and the test button to finish the calibration procedure.
- Release a test exposure.

Miscellaneous service issues

No further service or maintenance shall be performed on the DAP ionization chamber and the DAP display. Note that the warranty will become void if the DAP ionization chamber or the DAP display are opened or altered in any fashion.

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Chapter 1

Page 1 -2: Section "Tools, measurement and auxiliary devices required" completely revised.

Revision of the warning symbols.

Chapters 2 and 5

Revision of the warning symbols.

Chapter 6

Page 6 -1: Part No. for spray paint "medical blue" added.

Revision of the warning symbols.

Chapter 7: completely revised.

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